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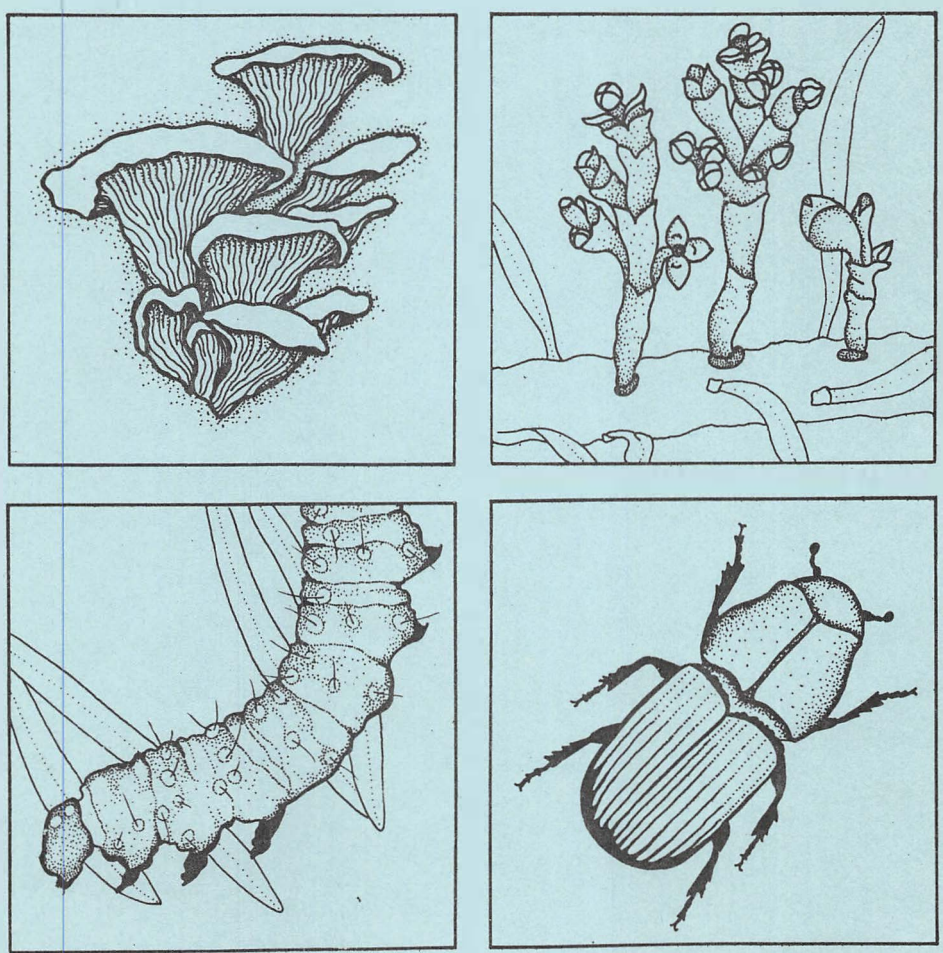
Status of Mountain Pine Beetle Kootenai National Forest,

Montana, 1979

by M. D. McGregor, K. E. Gibson, J. S. Hard
D. D. Bennett and H. E. Meyer



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April 1980

STATUS OF MOUNTAIN PINE BEETLE KOOTENAI NATIONAL FOREST, MONTANA 1979

By

M. D. McGregor, K. E. Gibson, J. S. Hard,
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ABSTRACT

Mountain pine beetle populations began building in the Kootenai National Forest in 1972. Infestations now encompass an estimated 48,599 acres of lodgepole pine type and 615 acres of ponderosa pine type. Approximately 25 percent of the high-risk stands, 17 percent of the moderate-risk, and less than 1 percent of the low-risk stands are infested. Newly attacked trees averaged 10 per acre. Infestations have the potential to intensify in high-risk stands, with some increase in moderate- and low-risk stands. Predicted trends, plus management alternatives to prevent and/or reduce infestation severity, are discussed.

INTRODUCTION

Beetle infestations began developing in mixed pine stands in 1972, and by 1974, 48,599 acres were infested (figure 1). Earliest outbreaks during this past decade developed in susceptible lodgepole pine stands in the Yaak and Fisher River drainages in 1972. Infested acreage has steadily increased on the Yaak and Rexford Ranger Districts (RD's) since 1974 and 1975 respectively. Area of visible faders (killed trees that are changing color) declined from 860 acres in 1976 to 612 acres in 1977, then increased to 4,314 acres through 1979 on the Fisher River RD.

A similar pattern developed on the Libby RD. Acres infested declined from 460 in 1975 to 285 in 1976, then increased to 1,745 acres by 1979. Area of infestation increased about 2.6 times yearly from 1977 to 1979 on the Fisher River and Libby RD's. High-risk stands on these Districts are being influenced by beetle immigration from heavily infested lodgepole pine stands in the adjacent Thompson River drainage, Plains RD, Lolo National Forest (NF).

On the Fortine RD, less than 100 acres were infested from 1974 through 1978, but increased to 435 acres by 1979. Beetle flight from the massive infestation in the North Fork of the Flathead River drainage will supplement inplace population buildup and probably speed up the time stands become heavily infested on the Fortine and Fisher River RD's.

Infestation also began developing in high-risk stands on adjacent State and private lands, and has continued since 1973.

Chronology of mountain pine beetle infestations on the Kootenai NF from 1973 to 1979 is shown in figure 2.

This survey was conducted in high-risk areas proposed for management to determine current status, buildup ratio, and potential for damage in 1980.

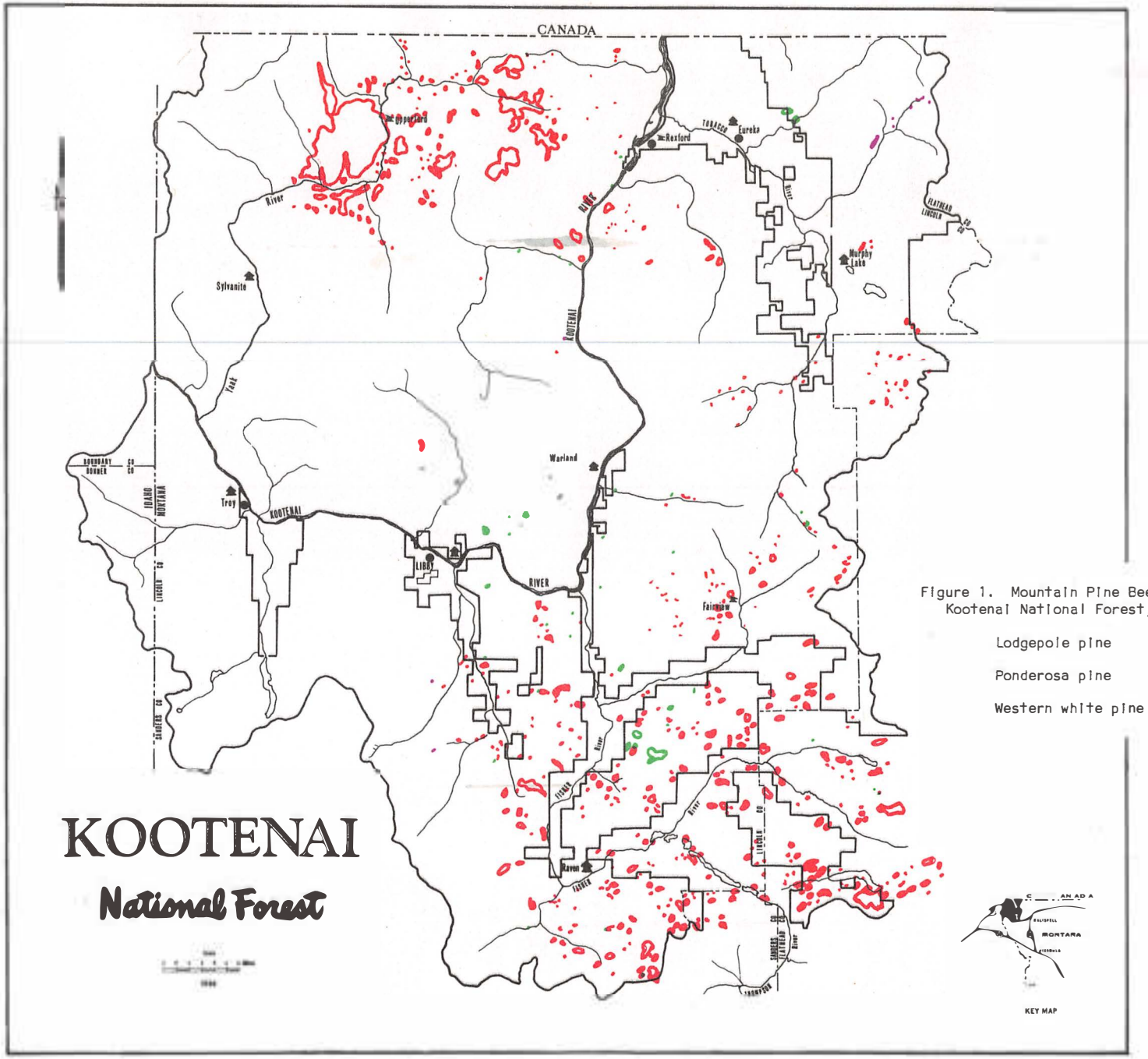
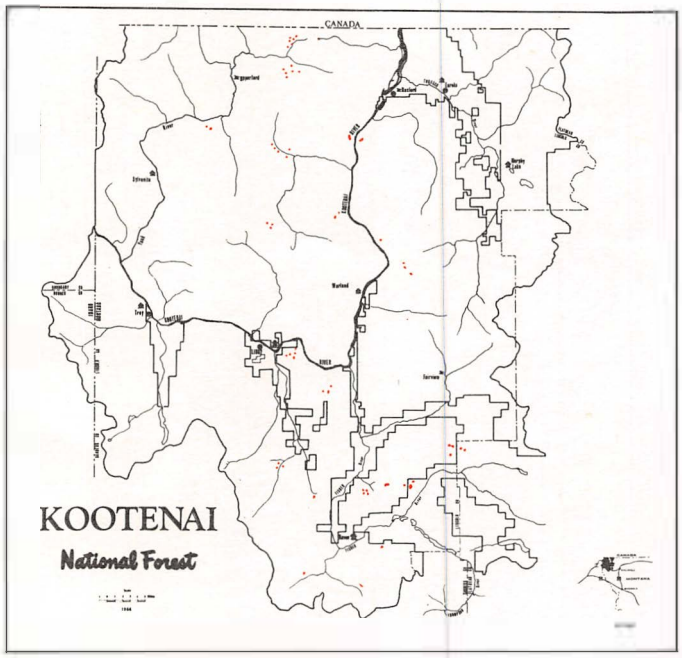


Figure 1. Mountain Pine Beetle Infestation Kootenai National Forest, Montana, 1979.

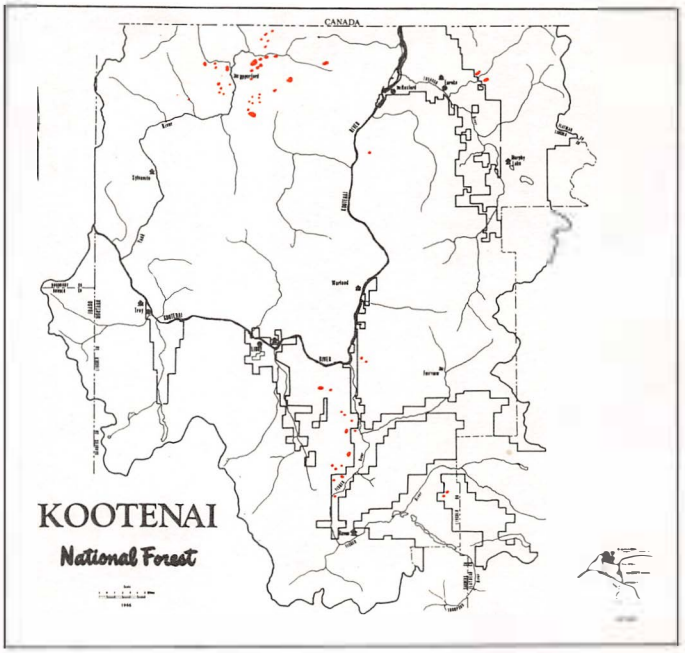
Lodgepole pine

Ponderosa pine

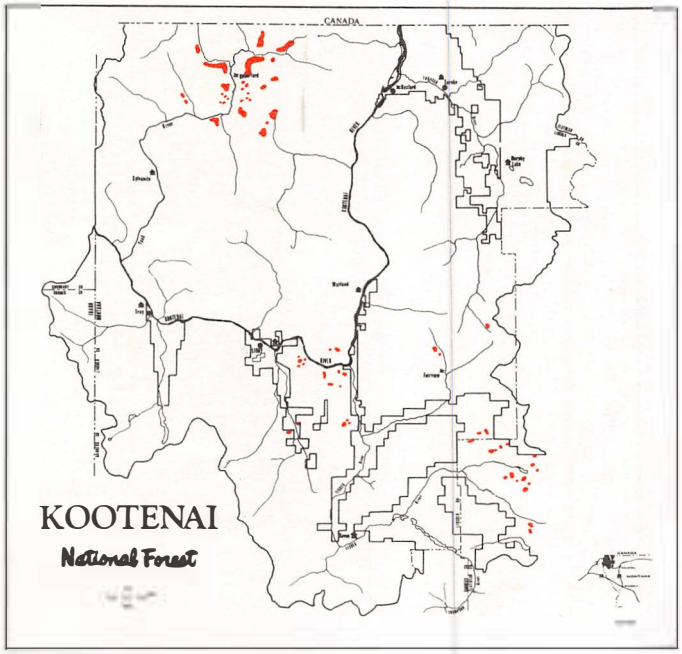
Western white pine



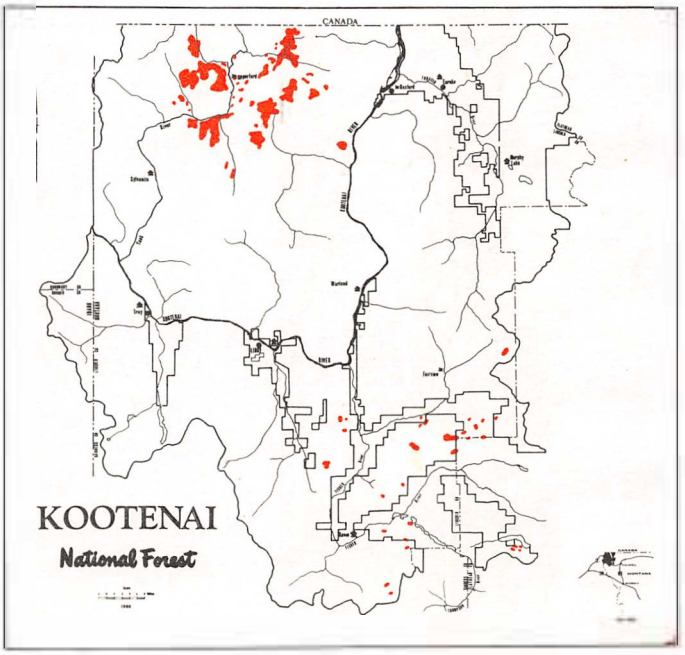
1973



1974

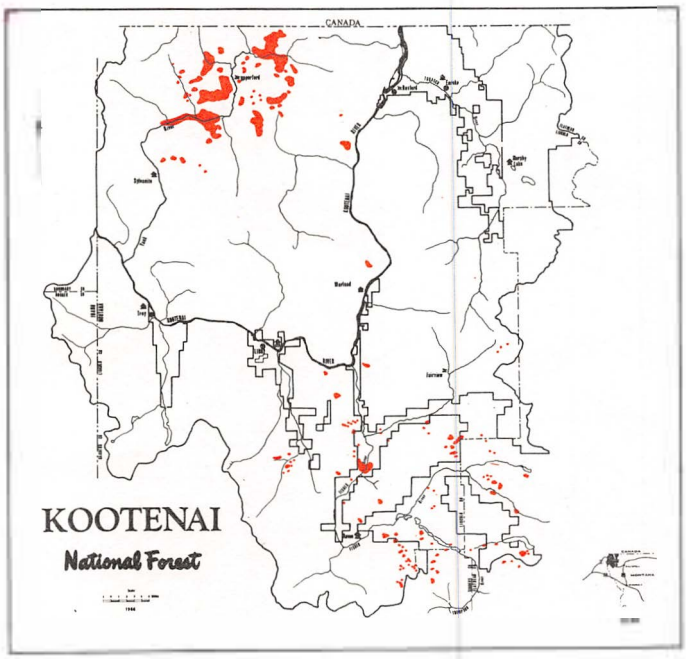


1975

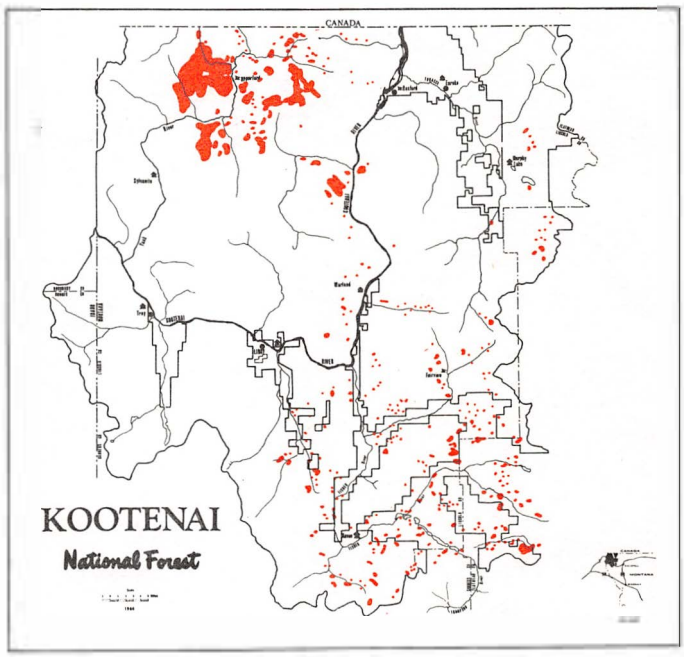


1976

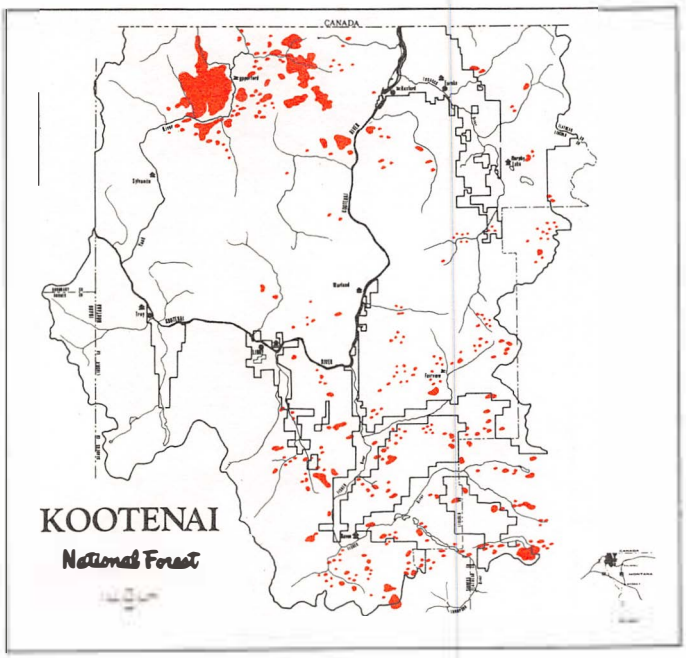
Figure 2.--Chronology of mountain pine beetle infestations, Kootenai National Forest, and adjoining State and private lands, Montana, 1973-1979.



1977



1978



1979

Figure 2.--Continued

SURVEY METHODS

To obtain an estimate not only of trees killed by year, but also of the remaining green trees, plots were established at 16 locations. At each location, 10 variable plots (basal area factor 10) were laid out at 5- by 5-chain spacing. At each plot, sample trees were selected by using a relaskop or 10-factor prism. All live trees, regardless of species, and all host trees with appropriate damage classification were tallied by diameter class.

Heights of the first two trees of each species were measured for volume estimates. In addition, regeneration data were recorded from 1/300-acre plots at each plot center. Data were analyzed using the computer program INDIDS (Bousfield 1977), and used for predicting future damage.

RESULTS

Table 1 summarizes data from sampled plots. Newly attacked trees were widely scattered and not encountered in plots from Kavilla and Thompson Lakes, Fisher River RD; Blessed Creek and Glen Lake, Fortine RD; and Boulder Lake, Rexford RD. This is typical of areas where infestations are building. Our survey showed the following numbers of susceptible lodgepole pine (>5 inches d.b.h.): 164/acre in Kavilla drainage, 42/acre at Thompson Lake, 324/acre in Blessed drainage, 109/acre at Glen Lake, and 268/acre in the Boulder Lake plots.

Buildup ratios of old to newly attacked trees were 1:0.8 from 1977 to 1978, and 1:5 from 1978 to 1979, Yaak RD; 1:0.1 from 1977 to 1978, and 1:1.7 from 1978 to 1979, Fisher River RD. One and one-half trees/acre were killed in 1977, none in 1978, and four trees/acre in 1979, Fortine RD. Less than one newly attacked tree was tallied/acre on the Rexford and Libby RD's.

Table 2 shows green trees/acre by species. Lodgepole pine comprises more than 50 percent of the green stands in all areas except on the Rexford RD where lodgepole comprises 41 percent. Data shows sufficient preferred host is available to sustain epidemic infestation for several years.

DISCUSSION

Acreage of mountain pine beetle infestation has increased steadily on the Yaak and Fisher River RD's since 1972. Infestations on the Libby and Fortine RD's have increased since 1973, and infestations on the Rexford RD have increased since 1975. Although beetle population buildup has been slower than in pure lodgepole pine stands on adjacent National Forests, acres infested have increased at about a 1:2 ratio yearly from 1974 through 1979.

In 1976, lodgepole pine stands on the Kootenai National Forest were risk rated for mountain pine beetle hazard. The hazard map is based on habitat type, average age of lodgepole pine, average tree diameter, elevation, and latitude (Hamel and McGregor 1976a). Management priorities were subsequently assigned to forest areas supporting significant lodgepole pine components >60 years old. 1/ Infestation by year, in areas rated high-, moderate-, and low-risk are shown in table 3.

In 1975, 5,110 acres, or 4 percent of the area, classed as high-risk were infested. No moderate- or low-risk acres were infested. By 1979, 29,413 acres of the high-risk area were infested (25 percent), 455 acres of the moderate-risk (17 percent), and 26 acres of the low-risk (<1 percent). Lodgepole pine type

1/ Personal communication, John R. Naumann, Silviculturist, Kootenai NF, 1975.

Table 1.--Summary of mountain pine beetle-caused tree and volume loss estimates, Kootenai National Forest, 1977-1979

Ranger District	Area	d.b.h.	Lodgepole pine/acre killed			Volume/acre killed bd. ft.			Remaining green lodgepole pine/acre	
			1977	1978	1979	1977	1978	1979	d.b.h.	trees
Yaak	Caribou	5-11.9	0	0	38.9	0	0	842	5-11.9	208.4
		>12	0	0.6	2.3	0	199	323	>12	8.8
		Total	0	0.6	41.2	0	199	1,165	Total	217.2
	Basin	5-11.9	20.4	3.2	2.2	513	310	138	5-11.9	147.7
		>12	3.1	1.8	6.9	538	468	1,540	>12	22.6
		Total	23.5	5.0	9.1	1,051	778	1,678	Total	170.3
	Benefield 10	5-11.9	2.8	5.8	40.0	--	--	1,136	5-11.9	25.0
		>12	2.2	2.2	2.0	--	--	144	>12	.4
		Total	5.0	8.0	42.0	--	--	1,280	Total	25.4
	Benefield 11	5-11.9	3.0	3.8	41.6	--	--	1,202	5-11.9	20.8
		>12	2.6	5.6	4.4	--	--	262	>12	--
		Total	5.6	9.4	46.0	--	--	1,464	Total	20.8
	Kootenai	5-11.9	1.3	0	0	186	0	0	5-11.9	19.6
		>12	2.4	0	3.0	516	0	604	>12	8.4
		Total	3.7	0	3.0	702	0	604	Total	28.0
	Waper	5-11.9	0	0	13.0	0	0	468	5-11.9	78.4
		>12	0	0	2.0	0	0	136	>12	7.5
		Total	0.4	7.6	15.3	0	0	604	Total	85.9
Fisher River	Fawn Creek	5-11.9	29.3	5.4	18.7	623	796	1,045	5-11.9	267.4
		>12	0	0	0	0	0	0	>12	2.4
		Total	29.3	5.4	18.7	623	796	1,045	Total	269.8
	W. Fk. Dry Creek	5-11.9	0	0	17.4	0	0	100	5-11.9	355.8
		>12	0	0	0	0	0	0	>12	
		Total	0	0	17.4	0	0	100	Total	355.8
	Calyx	5-11.9	1.9	0	3.1	123	0	127	5-11.9	213.9
		>12	0	0	1.2			109	>12	3.4
		Total	1.9	0	4.3	123	0	236	Total	217.3
	Kavilla	5-11.9	0	0	0	0	0	0	5-11.9	164.0
		>12	0	0	0	0	0	0	>12	.8
		Total	0	0	0	0	0	0	Total	164.8
	McGregor Creek	5-11.9	0	0	13.3	0	0	868	5-11.9	105.6
		>12	0	0	0	0	0	0	>12	2.4
		Total	0	0	13.3	0	0	868	Total	108.0
	Thompson Lake	5-11.9	0	0	0	0	0	0	5-11.9	38.2
		>12	0	0	0	0	0	0	>12	3.7
		Total	0	0	0	0	0	0	Total	41.9
Fortine	Sunday	5-11.9	4.6	0	9.3	105	0	610	5-11.9	244.6
		>12	0	0	4.0	0	0	683	>12	40.3
		Total	4.6	0	13.3	105	0	1,293	Total	284.9
	Blessed	5-11.9	0	0	0	0	0	0	5-11.9	301.7
		>12	0	0	0	0	0	0	>12	22.8
		Total	0	0	0	0	0	0	Total	324.5
	Glen Lake	5-11.9	0	0	0	0	0	0	5-11.9	94.3
		>12	0	0	0	0	0	0	>12	15.1
		Total	0	0	0	0	0	0	Total	109.4
Rexford	Boulder	5-11.9	0	0	0	0	0	0	5-11.9	267.9
		>12	0	0	0	0	0	0	>12	--
		Total	0	0	0	0	0	0	Total	267.9

Table 2.--Residual green stand all species in areas surveyed on Ranger Districts, Kootenai National Forest, 1979 (figures in percent)

Ranger District	d.b.h.	LPP	Larch	Douglas-fir	Subalpine fir	Engelmann spruce	Grand fir	Ponderosa pine
Yaak	0-4.9	15	2	2		22		
	5-11.9	36	7		2	4		
	>12	03	4			2		
	Total	55	13	2	2	28		
Fisher River	0-4.9	24	3	38				1.5
	5-11.9	26	3				0.5	
	>12	2	2					
	Total	52	8	38			0.5	1.5
Fortine	0-4.9	21	2	19	7	1		12
	5-11.9	26	1	4		1		1
	>12	3		.5				
	Total	50	3	23.5	7	2		13
Rexford	0-4.9	15	3	22	26	0		
	5-11.9	26	3	2	2	1		
	>12	--	--	--	--	--		
	Total	41	6	24	28	1		

Table 3.--Acres and percent infestation/hazard class/year, Kootenai National Forest, 1975-1979

Hazard class	1975		1976		1977		1978		1979	
	Acres	Percent infested	Acres	Percent infested	Acres	Percent infested	Acres	Percent infested	Acres	Percent infested
High	5,110	4	17,638	13	10,863	9	20,562	17	29,413	25
Moderate	0	0	0	0	827	3	495	18	455	17
Low	0	0	0	0	10	<1	615	25	26	<

classed moderate- and low-risk did not become infested until 1977. If the epidemic is allowed to run its natural course with no logging, nearly all of the high-risk stands, as well as a large portion of the moderate- and low-risk type, will be infested.

Management of high-risk stands has slowed the infestation and reduced the number of acres that have been infested. The following volume of lodgepole pine has been removed from high-risk stands since 1976: 3,585 acres containing 28 MMBF in 1976; 1,600 acres containing 21 MMBF in 1977; 1,495 acres containing 17 MMBF in 1978; 5,400 acres containing 46.3 MMBF in 1979, and 8,400 acres containing 72 MMBF are planned for harvest in FY 1980. 2/ Management includes salvage logging of infested trees and cutting green, high-risk stands prior to beetle infestation.

Safranyik 3/ identified the following six criteria for determining the probability of beetle immigration into susceptible areas:

1. Historic evidence of beetle activity in surrounding areas.

2. Recent beetle activity--within the past 3-5 years. Are beetle populations in surrounding areas increasing?

3. Stand parameters in the uninfested area. Are trees of a susceptible age and size class, and does the stand have a high percentage of host species?

4. Large continuous areas of high-risk, uninfested trees.

5. Major outbreaks near the uninfested area. Evidence shows beetle populations immigrate into, as well as develop in, a given stand.

6. Relationship of elevation and latitude.

Many of these same criteria have been incorporated into a risk rating system developed by Amman et al. (1977). Their criteria for high-risk stands are:

1. Average stand age >80 years.

2. Average stand diameter ≥8 inches d.b.h.

3. Elevation <6,000 feet (at 48°N. latitude).

Applying Amman et al. (1977) stand risk rating criteria using age, elevation, and average d.b.h., and by multiplying the factors 1=low, 2=moderate, and 3=high, a susceptibility classification for stands surveyed was obtained (table 4).

Lodgepole pine are high-risk in many areas surveyed. Moderate-risk areas include Benefield 10, Fawn, Calyx, and Kavilla drainages, Thompson and Glen Lakes, and Boulder Creek. The West Fork of Dry Cree' is low-risk. Based on this risk rating, average age of lodgepole pine is not a factor limiting epidemic infestation, and elevation and latitude will not be limiting factors in beetles completing one generation/year (Amman and Baker 1972; Amman et al. 1973; Safranyik et al. 1974). Average d.b.h. is a limiting factor in some areas. Data show that mortality can be excessive in stands rated moderate risk from beetles immigrating from high-risk, heavily infested stands. Also, lodgepole pine ≥8 inches d.b.h. are present in moderate risk stands which are capable of generating increasing beetle populations. Mortality and stand depletion will continue until beetle preferred trees are killed.

2/ Personal communication, Jerald Park, Silviculturist, Kootenai National Forest, 1980.

3/ Personal communication, Safranyik, L., Research Entomologist, Pacific Forest Research Centre, Victoria, BC, 1979.

Table 4.--Hazard rating for infested lodgepole pine stands surveyed, Kootenai National Forest, 1979

Ranger District	Area	Ave. age of LPP >5" d.b.h.		Elevation	Rating	Ave. d.b.h. of LPP >5" d.b.h.		Overall index	Hazard rating
		Years	Rating			Inches	Rating		
Yaak	Caribou	105	3	3700-4400	3	10.0	3	27	High
	Basin	115	3	3700-4400	3	9.8	3	27	High
	Benefield 10	110	3	3200-5500	3	7.7	2	18	Moderate
	Benefield 11	110	3	3200-5500	3	8.3	3	27	High
	Kootenai	110	3	2990-3200	3	11.0	3	27	High
	Waper	110	3	3000-4500	3	8.6	3	27	High
Fisher	Fawn Creek	100	3	3400-4400	3	7.7	2	18	Moderate
	W. Fk. Dry Creek	80	3	3800-5700	3	6.9	1	9	Low
	Calyx	90	3	3200-6500	3	7.6	2	18	Moderate
	Kavilla	90	3	3500-4800	3	7.4	2	18	Moderate
	McGregor	90	3	3800-4800	3	8.2	3	27	High
	Thompson Lake	90	3	3400-4400	3	7.5	2	18	Moderate
Fortine	Sunday	90	3	4000-5900	3	10.3	3	27	High
	Blessed	90	3	4000-5700	3	9.7	3	27	High
	Glen Lake	100	3	2800-6800	3	7.8	2	18	Moderate
Rexford	Boulder	90	3	3600-5000	3	7.9	2	18	Moderate

SUGGESTED MANAGEMENT ALTERNATIVES

Within the past several years, much valuable information has been obtained concerning manipulation of mountain pine beetle populations through appropriate stand management. Cole (1978) and Amman et al. (1977) have stated that infested and high-risk stands can be managed in several ways depending upon land use objectives and stand composition. Where stands contain a high number of large-diameter and older-age trees (high-risk), they can be broken up by small, organized clearcuts. This helps eliminate stands of large trees which are conducive to large population buildups of the beetle. Smaller stands which are high-risk or are approaching high-risk, can be completely removed.

Cole (1978) has summarized the following silvicultural practices for stands where composition is pure lodgepole pine and form is even-aged:

1. Stocking control in young stands.

2. Organized clearcutting in blocks to create age, size, and species mosaics from mature stands.

3. Salvage or partial cuts.

4. Salvage cutting to reduce mortality in stands under attack.

In uneven-aged, pure lodgepole pine and mixed species stands, the preventive practices mentioned for pure, even-aged lodgepole pine stands are also feasible (Cole 1978). In mature mixed species stands with large lodgepole pine in the overstory, block clearcutting is recommended to develop a mosaic pattern as a preventive measure. If already attacked, additional mortality can be reduced by salvaging infested trees. Selective cutting to remove

overstory lodgepole pine is recommended provided the residual trees are the desired species, age, and stocking level to maintain a productive stand. If immature, such stands are candidates for stocking control, with species discrimination possible while reducing stand density in mixed species stands.

Discrimination against lodgepole pine is possible in older mixed stands through partial cuts in which only the most susceptible lodgepole pine portion of the main stand is removed (Cole 1978).

Partial cutting has been shown as an effective treatment to reduce potential mortality in susceptible stands (Hamel and McGregor 1976; Cole and Cahill 1976; Hamel 1978). Where timber values are the primary concern, partial cuts for beetle management may be appropriate where only a small proportion of the trees are high-risk lodgepole, and where enough residual trees remain to maintain stand productivity (Amman 1976). Alexander (1975) cautions that partially opened lodgepole stands may be more susceptible to windthrow, dwarf mistletoe, and logging damage. He states that from a silvicultural viewpoint, partial cuts are the only option managers have where (1) multiple-use considerations preclude clearcutting, (2) combinations of cleared openings and high forest are required to meet forest management uses, and (3) regeneration of the stand is difficult after clearcutting.

One additional management alternative exists for those stands where single-tree esthetic values are primary. In campgrounds, summer home areas, or around administrative sites, high-value trees can be successfully protected from mountain pine beetle attack through the use of a preventive spray. Sevimol 4®, a water-soluble mixture of carbaryl insecticide in a molasses carrier, applied prior to beetle flight has proven to be a safe, economical, and highly efficient means of protecting individual trees (Gibson 1978).

Data (unpublished) from the Lolo National Forest show that selective cutting--removing some large as well as small diameter trees--has prevented and reduced beetle attack along visual areas such as roads and streams. This will also reduce stream channel siltation which could be created by clearcutting. Partial cutting, whether selectively leaving large and small diameter lodgepole pine, or a straight commercial thinning based on tree diameter regardless of crown, has prevented and/or reduced incidence of beetle attack in stands on the Plains Ranger District, Lolo National Forest. Finally, partial cutting can be applied as a last resort to salvage beetle-killed trees. An increased utilization of sound material and partial direct control of beetle populations by removing infested trees would buy time to accomplish preferred block cutting (McGregor et al. 1978).

REFERENCES CITED

Alexander, R. A. 1975. Partial cutting in old-growth lodgepole pine. USDA-Forest Service., Res. Pap. RM-136, 17 pp.

Amman, G. D., and B. H. Baker. 1972. Mountain pine beetle influence on lodgepole pine stand structure. J. of Forestry 70(4):204-209.

Amman, G. D., B. H. Baker, and L. E. Stipe. 1973. Lodgepole pine losses to mountain pine beetle related to elevation. USDA-Forest Serv., Res. Note INT-171, 8 p.

Amman, G. D. 1976. Integrated control of the mountain pine beetle in lodgepole pine forests. Proc. XVI IUFRO World Congr., Div. II, June 1976. Norway, pp. 439-446.

Amman, G. D., M. D. McGregor, D. B. Cahill, and W. H. Klein. 1977. Guidelines for reducing losses of lodgepole pine to the mountain pine beetle in unmanaged stands in the Rocky Mountains. USDA-Forest Serv., Gen. Tech. Rept. INT-36. 19 pp.

Bousfield, W. E. 1977. Forest insect and disease damage survey. USDA Forest Serv., State and Priv. Forestry, Missoula, MT.

Cole, W. E., and D. B. Cahill. 1976. Cutting strategies can reduce probabilities of mountain pine beetle epidemics in lodgepole pine. J. of Forestry 4:294-297.

Cole, D. M. 1978. Feasibility of silvicultural practices for reducing losses to the mountain pine beetle in lodgepole pine forests. In Theory and practice of mountain pine beetle management in lodgepole pine stands. MPB Symposium Proc., WSU, Pullman, WA. 224 pp.

Gibson, K. E. 1978. Results of a 1977 pilot project to evaluate the effectiveness of Sevin insecticide in preventing attacks by the mountain pine beetle in lodgepole pine on the Targhee National Forest, Idaho. USDA-Forest Serv., Ogden, UT, Rept. R-4, 78-4, 22 pp.

Hamel, D. R., and M. D. McGregor. 1976a. Evaluation of mountain pine beetle infestations--Lap, Cool, Lang, and Caribou Creek Drainages, Yaak Ranger District, Kootenai National Forest, Montana. USDA-Forest Serv., State and Priv. Forestry, Missoula, MT, Rept. 76-6.

Hamel, D. R., and M. D. McGregor. 1976. Harvesting strategies for management of mountain pine beetle infestations in lodgepole pine, Montana. USDA-Forest Serv., Northern Region, Missoula, MT, Prog. Rept., 11 pp.

Hamel, D. R. 1978. Results of harvesting strategies for management of mountain pine pine beetle infestations in lodgepole pine on the Gallatin. In Theory and practice of mountain pine beetle management in lodgepole pine forests. MPB Symposium Proc., WSU, Pullman, WA.

McGregor, M. D., D. R. Hamel, and S. Kohler. 1978. Status of mountain pine beetle infestations, Glacier National Park, and Glacier View Ranger District, Flathead National Forest, Montana, 1977. USDA-Forest Serv., Northern Region, Missoula, MT. Rept. 78-6, 14 pp.

Safranyik, L., D. M. Shrimpton, H. S. Whitney. 1974. Management of lodgepole pine to reduce losses from the mountain pine beetle. Pac. Forest Res. Centre, Canadian Forestry Serv., Victoria, BC, Forestry Tech. Rept. 1, 25 pp.